

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of : Kjell-Tore Smith, et al.

Serial No. 10/717461

Art Unit: 1793

Filed: 11/21/2003

Examiner: Felton

For: Pressable plastic-bound explosive composition

SUPPLEMENTAL APPEAL BRIEF

*Real Party in Interest*

The subject application is owned by the assignee, Dyno Nobel ASA, P.O. Box 10, N-3476, Sætre, Norway, as recorded in the USPTO at Reel/Frame 023104/0263..

*Related Appeals and Interferences*

None

### ***Status of Claims***

On 17 June, 2009 appellant appealed from the rejection of claims 1-5 and 7-42, said claims 1-5 and 7-35 having been twice rejected. Claim 6 has previously been cancelled.

### ***Status of Amendments***

No amendments have been presented after the filing of the Notice of Appeal.

### ***Summary of claimed subject matter***

Under the provisions of 37 CFR §41.37(c)(1)(v), the following summary of claimed subject matter is made. The summary is in accordance with the rules since the rules do not require any particular format for this section of the Appeal Brief.

### **Background**

The present invention relates to pressable explosive compositions with enhanced sensitivity characteristics and pressability.

RDX and HMX are crystalline explosive compounds, whose use has been known in the field of military pressable explosive compounds for a number of years. Pressable explosive compositions are traditionally employed for making charges for use in ammunition.

It has been known for quite some time that in order to stabilise RDX and HMX crystals and make them suitable for pressing into charges, the crystals can be coated with a stabilising substance. Initially, different variants of wax were mainly employed for coating the crystals. Subsequently,

more plastic materials have been employed, and in recent years compositions have been developed with more elastic plastic materials, in particular polyacrylic elastomers such as Hy Temp 4454.

When plastic-bound RDX or HMX are employed in ammunition, they are pressed into charges in order to achieve maximum density and thereby achieve maximum effect from the explosive. Another advantage with improved pressability is that it will offer the producer the possibility of making much larger charges than is the case with explosive of inferior pressability. This will provide economic gains, particularly since alternatives to these large charges will involve the use of far more expensive production processes (castable/hardenable and meltable/hardenable processes). There will always be a certain risk involved in pressing explosives however, and therefore every attempt is made to apply the lowest possible pressing pressure, generally referred to as improved pressability.

The pressability of explosive compositions is expressed as a percentage of the Theoretical Maximum Density (TMD) of the composition. In general it is difficult to achieve %TMD values above 96-97% without using sophisticated pressing procedures and optimized products. Industrially, values above 98% of TMD are hardly ever seen in charges. At this level of pressability, even fractional increases in density above 98% TMD are to be regarded as very significant. There is in fact a prejudice in the art that it is not possible to achieve densities over 99% TMD for plastic-bound RDX-based explosives, and that high pressure has to be applied in order to achieve over 98% TMD.

RDX and HMX have been available in a very large range of crystal sizes for many years. Explosives in which different crystal sizes are used together are known in the art as

"mutli-modal" explosive compositions. As used in the art, the term "bimodal" describes an explosive composition having two median particle sizes. Despite many years of work with various crystal sizes, there does not believe to have been reported a pressable RDX or HMX -based explosive composition having a density of > 98% TMD at low pressing pressures, or having a density of greater than 99% TMD at any pressure.

#### Claimed subject matter

As described in the specification at page 4, line 29 et seq, the present invention provides for explosive compositions based on crystalline explosive crystals of 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX) Type I alone or in combination with a smaller proportion of 1,3,5-tetranitro-1,3,5,7-tetrazacyclooctane (HMX). The crystals are coated with a binder system consisting of a polyacrylic elastomer (Hy Temp 4454 or Hy Temp 4054) to which a plasticizer is added (dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP)). The explosive compositions of the invention are muliti-modal, having crystal sizes within specifically defined ranges, with the compositions having a pressability of 98% TMD or greater at a pressure of 1000 bar or less. According to another aspect of the invention, these explosive compositions are produced in the so-called water-slurry process where the explosive crystals are washed in water whereupon a solution of the binder system is added. After the admixture the solvent is distilled off and the coated product is isolated by filtering.

#### Claim 1

The subject matter of independent claim 1, is an explosive composition comprising RDX Type I, a polyacrylic elastomer

and a plasticizer (see specification at page 4, lines 30-35), wherein the polyacrylic elastomer is Hy Temp 4454 (page 7, line 11) or Hy Temp 4054 (another recognized name for the elastomer, see page 2, line 28), and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP) (see page 7, lines 15-27), characterised in that the RDX crystals represent a proportion in the range 88-96% by weight of the composition (for the lower value see original claim 1 which is part of the original disclosure and example 4 at page 9, line 14. For the higher value see original claim 1 and example 5 at page 9, line 27) and that the RDX crystals comprise a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  (for the lower value see original claim 1 and example 1 at page 7, line 37. For the higher value see original claim 1 and examples 3, 4 and 5) and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$  (for the lower value see original claim 1 and examples 4 and 5, page 9 lines 8 and 21. For the higher value see original claim 1 and example 3, page 8, line 31).

#### Claim 2

The subject matter of independent claim 2 is an explosive composition essentially as that described in claim 1, but also comprising HMX (see page 4, line 33). The explosive crystals represent a proportion in the range 88-96% by weight of the total composition, wherein the HMX represents from 5 to 20% by weight of the explosive crystals. (See original claim 2 which forms part of the original disclosure, as well as example 2, page 8, line 22.)

#### Claim 9

Independent claim 9 provides for an explosive composition comprising 88-96% of a coarse-grained and a fine grained RDX type I explosive crystal, also having a polyacrylic elastomer and a plasticizer. The explosive according to claim 9 is specifically made by the water slurry process **(See the summary for claim 1 above regarding support for RDX crystals. See also page 4, line 35 to page 5 line 3. See also examples 1 and 3-5 wherein the characteristic steps of a water-slurry process as explained on page 4 are utilized, e.g. page 7, line 35 et seq, "RDX fed into reactor with water...DOA dissolved in ethyl acetate was then added while stirring.")**.

#### Claim 10

Independent claim 10 is similar to claim 9, albeit with the explosive composition also comprising HMX. This subject matter is also an explosive made by the water slurry process. **(see the summary for claim 2 above, as well as example 2 at page 8, line 10)**

#### Claim 36

The subject matter of claim 36 is a bimodal explosive composition defined by the explosive crystals (RDX, HMX or combinations thereof), a polyacrylic elastomer and a plasticizer **(see the summary for claims 1 and 2 for support for these features)**, further defined by the feature of a pressability of 98% TMD at a pressure of 1000 bar or less. **(See Fig 1, as well as the specific pressability values from examples 1-5 at pages/lines 8/6, 8/23, 9/2, 9/15, 9/27, 10/2)**

***Grounds of rejection to be reviewed on appeal***

Ground 1:

Claims 1, 3-5, 9, 11-14, 17-22 and 27-31 stand rejected under 35 USC §103(a) as being unpatentable over Han (US 6485587) in view of Svenson (US4638065).

Ground 2:

Claims 2, 7, 8, 10, 15, 16, 22-26, and 32-35 stand rejected under 35 USC §103(a) as being unpatentable over Han (US 6485587) in view of Svenson (US4638065), in further view of Godsey (US4298411).

Ground 3:

Claims 36-40 stand rejected under 35 USC §102(e) as anticipated by, or in the alternative, under 35 USC §103(a) as obvious over Rudolf, "IMPROVED INSENSITIVE HYTEMP/DOA BONDED HMX AND RDX MIXTURES BY PASTE PROCESS", (2003 Insensitive Munitions and Energetic Materials Technical Symposium, 10-13 March 2003 in Orlando, USA).

Ground 4:

Claims 41 and 42 stand rejected over as being unpatentable over Rudolf, "IMPROVED INSENSITIVE HYTEMP/DOA BONDED HMX AND RDX MIXTURES BY PASTE PROCESS", (2003 Insensitive Munitions and Energetic Materials Technical Symposium, 10-13 March 2003 in Orlando, USA), in view of Han (US 6485587), Svenson (US4638065), and Godsey (US4298411).

## **Argument**

### **Ground 1:**

#### **1. legal standard**

In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious.

*Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983)

After the Supreme Court decision in *KSR International Co. v. Teleflex Inc.*, 550 U.S. \_\_\_, \_\_\_, 82 USPQ2d 1385, 1396 (2007), the UPTO has issued guidelines for evaluating obviousness, listing exemplary rationales. (MPEP §2141). Rationale "A" therein involves "Combining prior art elements according to known methods to yield *predictable* results", while rationale "E" therein relating to an "obvious to try" rejection requires choosing from a finite number of identified, *predictable* solutions, with a reasonable expectation of success. In order to support an obviousness rejection after *KSR* it is therefore necessary for the examiner to identify a limited number of identified possible choices of elements from the prior art, explain that the combination of those identified choices would be a *predictable* solution, having a reasonable expectation of success, to one skilled in the art when considering the invention as a whole.



## 2. Claim construction

Independent Claim 1 and claims dependent therefrom provide for a bimodal explosive composition wherein, inter alia, RDX type I crystals represent a proportion in the range 88-96% by weight of the composition, and that the RDX crystals comprise a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$ .

## 3. Analysis - claim 1

The examiner cites the primary reference to Han (US 6485587) as teaching a bimodal RDX explosive composition made by the water slurry process. The examiner acknowledges that Han does not teach the particular particle sizes claimed in the present invention. The examiner relies upon the secondary reference to Svenson (US 4638065) to supply the missing particle sizes.

### A. Lack of prima facie case

*i. The examiner has not identified any combination of references teaching all of the limitations of the claims*

Regarding claim 1, the primary reference to Han does not disclose a bimodal RDX explosive composition. The examiner states at page 2, item 3 of the Office Action that:

"Han et al. discloses an explosive composition comprising bimodal HMX or RDX. Example 5 [sic] discloses bimodal HMX with 51% of Class 1, 41% of Class 5, 2% of Hytemp 4454 , and 6% of DOA."

In Han it is in fact example 4, at column 6, line 15 that discloses a bimodal composition, but this composition comprises 92% HMX. The examiner is therefore in error in his assertion that Han discloses a bimodal HMX or RDX composition. Claims 1 and 2 of the present application specify an explosive composition in which RDX crystals represent from 88%-96% of the composition. Even if one were to combine the particle sizes from Svenson with example 4 from Han, the resulting combination would not contain from 88%-96% RDX.

*ii. The examiner has not established a prima facie case according to the legal standard as expressed above*

The primary reference to Han describes a method for coating crystals for plastic-bound explosives. The purpose of the method in Han is to achieve a high quality coating of the crystals (see Han at col 1, line 55, and col 2, line 30). It so happens that in one of the examples Han uses an explosive mixture having different crystal sizes of HMX, however the crystal sizes are unrelated to the purpose of Han's invention. As evidence of this fact, Han does not describe the particular crystal sizes, and make no reference to crystal sizes in the claims. In his claims, Han simple refer to adding "explosive material" to the mixing kettle, and makes no mention to the particular particle sizes having any identified effect at all. In particular, Han does not teach that one can achieve a higher pressability of the explosive composition by the choice of particle size, and contains no teaching or suggestion that an unexpected pressability of greater than 98% TMD at pressures of less that 1000 bar is possible by the use of a specific combination of particle sizes.

The examiner cites Svenson for supplying the particle sizes missing from Han. The examiner makes two contentions regarding Svenson:

1. That Svenson discloses bimodal HMX and RDX of size 10 and 70 microns (ex. 1, 3 and 4), and
2. That it would have been obvious for one skilled in the art to use the particle sizes taught by Svenson with bimodal RDX and HMX as taught by Han, in the particular combination as claimed in the present invention

It is respectfully believed that both of these assertions are in error, and do not establish a case of obviousness under the correct legal standard.

In the first instance, as discussed above Han does not disclose a bimodal RDX composition, but rather a bimodal HXM composition. The examiner identifies no rationale why one skilled in the art would substitute the HMX of Han with RDX.

Secondly, Svenson does not teach "bimodal RDX" as asserted by the examiner. In fact, the term "bimodal RDX" is a non sequitur. It is well known in the art that the term "bimodal" describes an explosive composition having two median particle sizes. The particles themselves are not "bimodal", but rather the composition is "bimodal" if it comprises two different particles sizes.

Svenson however does not disclose a bimodal explosive comprising different particle sizes of RDX or HMX. Svenson simply describes a method for precipitation recrystallization of HMX and RDX crystals. The reference discloses that the resulting individual crystal sizes produced by the method may be in the range 10 - 250  $\mu\text{m}$ . While the examiner contends that examples 1, 3 and 4 show a bimodal mixture with crystal sizes of 10 and 70  $\mu\text{m}$ , this

is respectfully believed to be a misreading of the reference. The cited examples do not disclose bimodal mixtures at all, but merely discuss the size of some of the individual particles that result from the particular precipitation method. As such, Svenson discloses nothing more than the existence of a large range of possible individual particles sizes of HMX or RDX. This is not a significant teaching, however, as various individual particle sizes of RDX and HMX have been known for years.

At column 1, line 30 et seq, Svenson discusses bimodal explosives in general, and explains that in theory there are two ways one could arrive at a bimodal composition, namely by either directly recrystalizing HMX with a specific particle size distribution, or in the alternative, by recrystalizing individual sizes of HMX and then mixing the particle sizes together. At line 36, Svenson states that to his knowledge, no one has been able to make a bimodal explosive by directly recrystalizing HMX with a specific particle size distribution. More importantly, at line 42, Svenson states that his method does not do this either! Svenson states that his method simply permits the reproducible crystallization of select, *single*, sizes, but never discloses an explosive composition having any particular combination of the single sizes he produces.

The important question for evaluating the patentability of the current claim 1 under §103 is therefore whether it would have been obvious to choose the particular particle sizes of RDX, in the particular combination as claimed in the current invention, from among all of the possible individual particle sizes that can be produced by the method of Svenson, and use those sizes to modify the HMX composition disclosed in Han.

As stated above, the correct legal standard requires that the examiner identify a finite number of possible choices, and

explain why choosing the claimed particle sizes would have been a predictable solution to one skilled in the art. It is respectfully believed that the examiner has failed to establish such an initial showing.

As discussed above, Han does not disclose or suggest any effect from a specific bimodal size distribution of particles in a pressable explosive. Likewise Svenson does not make any suggestion that a particular size distribution can have any type of effect, and in particular no suggestion that a specific combination could result in the extremely surprising degree of pressability achieved by the inventors.

In the examples, Svenson discloses that some of the sizes he is able to produce fall within the ranges for the particle sizes for the currently claimed bimodal composition, namely 70 and 10 microns respectively. But crystals of these sizes are not new. Crystals having a particle size within the claimed ranges have been known in the art for years (though importantly never combined together in a bimodal explosive). Svenson does not teach which of the sizes he is able to produce *should be* used together in a bimodal explosive composition, simply that these are two (of the vast number of) sizes that can be produced individually using his method. The correct legal standard requires that the choice of particle sizes be a predictable solution. That predictability cannot be found within the references to either Han nor Svenson.

The examiner appears to acknowledge that Svenson itself does not suggest to use particle sizes of 10 and 70 microns together in a bimodal composition, because on page 3 of the Office Action the examiner simply asserts that it would have been obvious to use the particle sizes taught by Svenson since these are known particles sizes for use in bimodal compositions. This is respectfully believed not rise to the level of establishing a

*prima facie* case of obviousness, since it does not consider the invention as a whole.

It is not enough that the individual sizes are known for use separately in bimodal compositions. Rather it is the combination of these particular sizes that must be obvious. As held by the Federal Circuit:

In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983) (emphasis added)

Here it is respectfully believed that the examiner has failed to identify why the particularly claimed combination (invention as a whole) would be obvious, from among the almost infinite number of combinations possible from the individual particle sizes that can be made from the Svensen method.

The examiner appears to be arguing that that it would have been obvious for one skilled in the art to try and combine the particle sizes disclosed in examples 1, 3 and 4 of Svenson into a bimodal explosive composition simply because they are mentioned within a few paragraphs of each other in his recrystallization method patent. This argument does not satisfy the correct legal standard, however. As USPTO Guideline "E" explains, an "obvious to try" rejection requires choosing from a finite number of identified, *predictable* solutions, with a reasonable expectation of success. Here these criteria are not met. There are a vast, almost infinite number of possible

particle size combinations for a bimodal explosive, none of which can reasonably be argued to have predicable results. The fact that both of the particles sizes from the claimed invention are coincidentally mentioned in Svenson (without any suggestion to combine them) does not make their combination a predictable solution having a predictable result.

The examiner asserts that it is obvious to vary the amounts and sizes of RDX and HMX "to achieve a desired result", but does not identify what the "desired result" would be. "Obvious to try" is not a licence to conduct a fishing expedition to achieve any and all unidentified "desired" results. The examiner must at least identify what the "desired result" would be, and then explain why the claimed particle sizes would predictably provide that "desired result".

#### B. Alternative rebuttal of the prima facie case

Arguing in the alternative, even if the examiner has established a prima facie case of obviousness, the appellant respectfully believes that that case has been rebutted.

As noted in the background section, there is a prejudice in the art regarding the pressability of plastic-bound RDX explosives. This prejudice in the art is evidenced by the cited art, as well as the attached Declaration of explosives expert Gunnan Nevstad. As explained therein, a known RDX-based composition with the same binder as the claimed invention is PBXW-17, subsequently also known as PBXN-10, consisting of 94% RDX Type II (which contains some HMX) and 6% binder consisting of a 1:3 mixture of Hy Temp 4454 and DOA. This composition was first described in a lecture with associated article by Kirk Newman and Sharon Brown ("Munition Technology Symposium IV and Statistical Process

Control Conference" in February 1997 in Reno, NV). Newman et al. described PBXW-17 produced in a water-slurry process where the binder, dissolved in ethyl acetate, was added in two portions. A number of studies of pressing amongst other things were carried out in this process. From the results of these studies it is claimed that it is difficult to press PBXW-17 to densities over 99% TMD (TMD is known to a person skilled in the art as theoretical maximum density). The reason why it is impossible to achieve higher density than 99% is claimed to be due to the binder's elastomeric character. Newman et al. further illustrate in a figure that a pressing pressure of over approximately 1350 bar has to be applied in order to achieve over 98% TMD and that pressing pressure over 1520 bar does not noticeably increase the density.

Since the current invention achieves a result that is contrary to such a prejudice in the art, it is believed that the appellant has submitted strong evidence that the selection of the particular particle sizes as claimed would not have been a predictable solution to one skilled in the art giving a predictable result.

Nevstad further explains that due to issues of safety and production costs the pressability of plastic-bound explosives is a problem that is very important to the explosives industry. The fact that no one has previously reported a composition having the pressability of the current invention is believed strong evidence that the claimed composition is not obvious.



Separate argument for claims 3-5, 9, 11-14, 17-22 and 27-31

The claims dependent from claim 1 add additional limitations to the ranges of particles sizes. The arguments above apply therefore with more particularity to these limitations.

**Ground 2:**

1. legal standard

The same legal standard as discussed above applies for ground 2.

2. Claim construction

Independent Claim 2 contains the same limitations as Claim 1, but further provides that HMX crystals represent a proportion in the range from 5 to 20% by weight of the explosive crystals in the composition.

3. Analysis - claim 2

The examiner has cited Godsey for the proposition that it is known to use a combination of RDX and HMX in a explosive composition.

A. Lack of prima facie case

*i. The examiner has not identified any combination of references teaching all of the limitations of the claims*

As discussed in relation to ground 1, the primary reference to Han does not disclose a bimodal explosive composition having from 88-96% by weight of RDX crystals (the example cited discloses 91% HMX). The combination of Han and Svenson with the reference to Godsey still does not result in the claimed percentage of RDX.

*ii. The examiner has not established a prima facie case according to the legal standard as expressed above*

The appellant asserts the same arguments as above with respect to ground 2. In addition it is noted that the reference to Godsey relates to propellants, not to explosives, and is thus from non-analogous art. One skilled in the art of pressable plastic explosives would not refer to a propellant reference to solve a problem related to the pressability of an explosive composition. In the attached Declaration, expert Nevstad explains on page 1, paragraph 2, and on page 4, paragraph 2 why one skilled in the art would not look to a propellant reference for guidance in solving a problem related to explosives.

Separate argument for claims 7, 8, 10, 15, 16, 22-26, and 32-35  
The claims dependent from claim 2 add additional limitations to the ranges of particles sizes. The arguments above apply therefore with more particularity to these limitations.

### Ground 3

#### 1 legal standard

With respect to the rejection under §102, all of the limitations must be present in a single reference. With respect to the alternative rejection under §103, the same legal standard as discussed above for grounds 1 and 2 apply for ground 3.

#### 2. Claim construction

Independent claim 36 provides for a bimodal RDX explosive composition having, inter alia, a pressability of 98% TMD or greater at a pressure of 1000 bar or less.

#### 3. Analysis - claim 36

##### A. No anticipation, or in the alternative no prima facie case of obviousness

*i. The examiner has not identified a single reference (or any combination of references) teaching all of the limitations of the claims*

Claim 36 defines a product having a pressability of >98% TMD at pressure of 1000 bar or less. Rudolf at page 2 however identifies a composition having a pressability of > 98% TMD, but at a pressure of 1.2 kbar. The specific claim limitations of

claims 36 are therefore not taught by Rudolf, nor by any combination of cited references.

Separate argument for claims 37-40

The claims dependent from claim 36 add additional limitations to the ranges of density parameters. The arguments above apply therefore with more particularity to these limitations.

Ground 4

1. legal standard

The same legal standard as argued for grounds 1 and 2, and the arguments with respect to \$103 as discussed above for ground 3, apply for ground 4.

2. Claim construction

Claim 41 provides for a bimodal RDX explosive composition having, inter alia, the pressability parameters from claims 36-40, as well as specific limitations regarding particle size ranges.

3. Analysis - claims 41 and 42

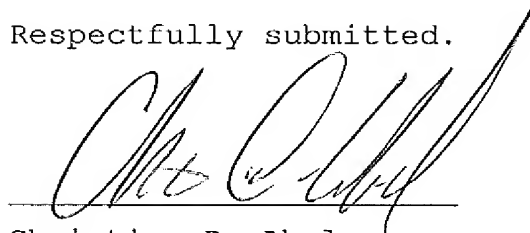
In addition to the argument presented with respect to claim 36, the arguments from grounds 1 and 2 apply with respect to claims 41 and 42 since these claims contain the limitations regarding % TMD as well as limitations regarding specific particle size

ranges. The arguments apply with particularity since the addition of the limitations of % TMD would lead one skilled in the art to look for a solution to a particular problem not identified by the examiner, nor related to the cited art.

**Conclusion**

For the foregoing reasons, it is respectfully believed that the claims on appeal are patentable in light of the cited art.

Respectfully submitted.

A handwritten signature in dark ink, appearing to read 'C. D. Abel', is written over a horizontal line.

Christian D. Abel

Reg no. 43,455

## CLAIMS APPENDIX

1. (previously presented) An explosive composition comprising RDX Type I, a polyacrylic elastomer and a plasticizer, wherein the polyacrylic elastomer is Hy Temp 4454 or Hy Temp 4054, and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP) characterised in that the RDX crystals represent a proportion in the range 88-96% by weight of the composition, and that the RDX crystals comprises a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$ .

2. (original) An explosive composition comprising RDX Type I and HMX, a polyacrylic elastomer and a plasticizer, wherein the polyacrylic elastomer is Hy Temp 4454 or Hy Temp 4054, and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP) characterised in that the explosive crystals represent a proportion in the range 88-96% by weight of the total composition, that the RDX crystals comprises a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$ , and that the HMX crystals represent a proportion in the range from 5 to 20% by weight of the explosive crystals in the composition.

3. (previously presented) An explosive composition according to claim 1 or 2, characterised in that the explosive crystals represent from 90 to 94% by weight of the composition.

4. (previously presented) An explosive composition according to claim 1 or 2, characterised in that the coarse portion of the RDX crystals comprises crystals with an average size in the range 60 to 170µm, and that the fine portion of the RDX crystals has an average size in the range 5-20µm.
5. (previously presented) An explosive composition according to claim 1 or 2, characterised in that the coarse portion of the RDX crystals represents from 25 to 75% by weight.
6. (cancelled)
7. (previously presented) An explosive composition according to claim 2, characterised in that the portion of HMX crystals represents from 5 to 20% by weight, of the total quantity of explosive crystals in the composition.
8. (previously presented) An explosive composition according to claim 2, characterised in that the HMX crystals have an average size in the range from 2 to 30µm.
9. (original) An explosive composition produced in a water-slurry process, characterised in that it comprising 88-96% of a coarse-grained and fine-grained RDX Type I and a binder system consisting of a polyacrylic elastomer and a plasticizer, and where RDX is present in a proportion of relatively coarse-grained and a proportion of fine-grained crystals.
10. (original) An explosive composition produced in a water-slurry process, characterised in that it consists of 88-96% of explosive crystals and a binder system comprising a polyacrylic

elastomer and a plasticizer, where the explosive crystals are a mixture of RDX crystals of Type I and HMX crystals, and where RDX is present in a proportion of relatively coarse-grained and a proportion of fine-grained crystals.

11. (original) An explosive composition according to claim 9 or 10,

characterised in that the proportion of explosive crystals represents from 90 to 94% by weight and preferably from 91 to 93% by weight of the total composition.

12. (previously presented) An explosive composition according to claim 9 or 10,

characterised in that the coarse portion of the RDX crystals comprising crystals with an average size in the range 60 to 170µm, and that the fine portion of the RDX crystals has an average size in the range 5-20µm.

13. (previously presented) An explosive composition according to claim 9 or 10,

characterised in that the coarse portion of the RDX crystals represents from 25 to 75% by weight.

14. (original) An explosive composition according to claim 9 or 10,

characterised in that the polyacrylic elastomer is Hy Temp 4454 or Hy Temp 4054, and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP).

15. (previously presented) An explosive composition according to claim 11,

characterised in that the proportion of HMX crystals represents from 5 to 20% by weight, of the total quantity of explosive crystals in the composition.



16. (previously presented) An explosive composition according to claim 11, characterised in that the HMX crystals have an average size in the range from 2 to 30µm, .
17. (previously presented) An explosive composition according to claim 3, characterised in that the explosive crystals represent from 91 to 93% by weight of the composition.
18. (previously presented) An explosive composition according to claim 4, characterised in that the coarse portion of the RDX crystals comprises crystals with an average size in the range 60-90µm, and that the fine portion of the RDX crystals has an average size in the range 5-20µm.
19. (previously presented) An explosive composition according to claim 4, characterised in that the coarse portion of the RDX crystals comprises crystals with an average size in the range 60 to 170µm, and that the fine portion of the RDX crystals has an average size in the range 12-18µm.
20. (previously presented) An explosive composition according to claim 4, characterised in that the coarse portion of the RDX crystals comprises crystals with an average size in the range 60-90µm, and that the fine portion of the RDX crystals has an average size in the range 12-18µm.
21. (previously presented) An explosive composition according to claim 5, characterised in that the coarse portion of the RDX crystals represents from 35 to 65% by weight.

22. (previously presented) An explosive composition according to claim 5, characterised in that the coarse portion of the RDX crystals represents from 44 to 56% by weight.
23. (previously presented) An explosive composition according to claim 7, characterised in that the portion of HMX crystals represents from 5 to 15% by weight of the total quantity of explosive crystals in the composition.
24. (previously presented) An explosive composition according to claim 7, characterised in that the portion of HMX crystals represents from 9 to 11% by weight of the total quantity of explosive crystals in the composition.
25. (previously presented) An explosive composition according to claim 8, characterised in that the HMX crystals have an average size in the range from 5 to 20 $\mu$ m.
26. (previously presented) An explosive composition according to claim 8, characterised in that the HMX crystals have an average size in the range from 8 to 14 $\mu$ m.
27. (previously presented) An explosive composition according to claim 12, characterised in that the coarse portion of the RDX crystals comprising crystals with an average size in the range 60-90 $\mu$ m, and that the fine portion of the RDX crystals has an average size in the range 5-20 $\mu$ m.
28. (previously presented) An explosive composition according to claim 12, characterised in that the coarse portion of the RDX crystals

comprising crystals with an average size in the range 60 to 170 $\mu$ m, and that the fine portion of the RDX crystals has an average size in the range 12-18 $\mu$ m.

29. (previously presented) An explosive composition according to claim 12, characterised in that the coarse portion of the RDX crystals comprising crystals with an average size in the range 60-90 $\mu$ m, and that the fine portion of the RDX crystals has an average size in the range 12-18 $\mu$ m.

30. (previously presented) An explosive composition according to claim 13, characterised in that the coarse portion of the RDX crystals represents from 35 to 65% by weight.

31. (previously presented) An explosive composition according to claim 13, characterised in that the coarse portion of the RDX crystals represents from 44 to 56% by weight.

32. (previously presented) An explosive composition according to claim 15, characterised in that the proportion of HMX crystals represents from 5 to 15% by weight—of the total quantity of explosive crystals in the composition.

33. (previously presented) An explosive composition according to claim 15, characterised in that the proportion of HMX crystals represents from 9 to 11% by weight of the total quantity of explosive crystals in the composition.

34. (previously presented) An explosive composition according to claim 16, characterised in that the HMX crystals have an average size in the range from 5 to 20 $\mu$ m.

35. (previously presented) An explosive composition according to claim 16, characterised in that the HMX crystals have an average size in the range from 8 to 14 $\mu$ m.

36. (previously presented) A bimodal explosive composition comprising explosive crystals of RDX, HMX, or combinations thereof , a polyacrylic elastomer and a plasticizer, wherein the composition has a pressability of 98% TMD or greater at a pressure of 1000 bar or less.

37. (previously presented) A bimodal explosive composition according to claim 36, having a pressability of 98% TMD or greater at a pressure of 500 bar or less.

38. (previously presented) A bimodal explosive composition according to claim 36, wherein the explosive crystals are RDX, and wherein the composition has a pressability of 98% TMD or greater at a pressure of in the range of 250 to 1000 bar,.

39. (previously presented) A bimodal explosive composition according to claim 36, having a pressability of 99% TMD or greater at a pressure in the range of 500 to 1000 bar.

40. (previously presented) A bimodal explosive composition according to claim 36, having a pressability of 99% TMD or greater at a pressure in the range of 250 to 500 bar.

41 (previously presented) A bimodal explosive composition according to any one of claims 36-40, wherein the polyacrylic elastomer is Hy Temp 4454 or Hy Temp 4054, and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl

phthalate (DOP), and further wherein RDX crystals represent a proportion in the range 88-96% by weight of the composition, and that the RDX crystals comprises a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$ .

42. (previously presented) A bimodal explosive composition according to either of claims 36-40, wherein the polyacrylic elastomer is Hy Temp 4454 or Hy Temp 4054, and that the plasticizer is dioctyl adipate (DOA), dioctyl sebacate (DOS), isodecyl pelargonate (IDP), dioctyl maleate (DOM) or dioctyl phthalate (DOP), and further wherein the explosive crystals represent a proportion in the range 88-96% by weight of the total composition, that the RDX crystals comprises a portion of coarse crystals with an average crystal size in the range 50 to 250  $\mu\text{m}$  and a portion of finer crystals with average crystal size in the range 2 to 30  $\mu\text{m}$ , and that the HMX crystals represent a proportion in the range from 5 to 20% by weight of the explosive crystals in the composition.

EVIDENCE APPENDIX

Attached is the Declaration under 37 CFR §1.132 of Gunnar Nevstad dated 31 October, 2007.

RELATED PROCEEDINGS APPENDIX

- none -

MOTTATT  
31 OKT 2007

## IN THE UNITED STATES PATENT OFFICE

Kjell-Tore Smith, et al  
Serial No. 10/717461  
Filed: 11/21/2003  
Title: Pressable plastic-bound explosive composition  
Examiner: Gellner Group no. 3643  
Atty docket no. 115700

## DECLARATION UNDER 37 CFR §1.132

I, Gunnar Nevstad, hereby DECLARE as follows:

In relation to the invention in US 10/717, 461, I have been asked to comment the case. I am familiar with the application, the last office action from the examiner, and the references to Newman and Rothstein. I am a MSc in chemistry from the university of Bergen, Norway and I have been working as scientist and as principal scientist since 1985 at the Norwegian Defence Research Establishments. My area of expertise through all these years has been related to energetic materials i.e. high explosive formulations as well as gun and rocket propellants. I am in no way related to the applicant and have an independent position. The following statements are made of my own knowledge and belief. I understand fully that the making of wilful false statements in a Declaration is a criminal offence.

Basically it is important to understand the lines between PBX and propellants. Further it is important to understand the differences between various PBX groups of materials and why we distinguish these groups of materials from each other. The processing technology applied for pressable PBX compositions (including the current invention) is completely different from the processing technology of cast/cure PBX, melt/cast PBX and castable propellants.

Pressable PBX materials are to be pressed or compacted into various warheads. The explosive granules are filled into a tool and compacted by applying pressure. This is considered to be a relatively dangerous operation depending on the pressure applied. Industrially the typical force range is 1500-2000 kg/cm<sup>2</sup>. There are a number of pressable formulations available and in use in the ammunition business such as PBXN-3, PBXN-5, LX-14, PBXN-9 etc. When applied as main charge the producer would like to achieve the highest density possible without risking an accident. High density means high performance and a less shock sensitive charge, which is of



increasing importance today in order to produce so called Insensitive Munitions (IM) compliant munitions. The resultant density is typically expressed as % of Theoretical Maximum Density. In order to maximize the density of the finished charge a number of various parameters are optimized such as heat, vacuum, pressing force, pressing cycles and pressing tool (single-end, double-end, isostatic). Obviously the characteristics of the granules themselves are influencing the result as well, i.e. granule size and size distribution, type and quantity of binder material, quality of crystal coating and the crystal size distribution of the applied crystals in the granules. During pressing all the above-mentioned parameters are interacting. It is difficult to rank the importance of the various parameters in order to achieve the highest density. For instance, during pressing the crystal size distributions will change as a result of the force applied (crushing). For a person skilled in the art all the above mentioned parameters are well known and in the literature you will find details described on each and every single parameter. In general it is hard to achieve %TMD values above 96-97% without using sophisticated pressing procedures and optimized products. Industrially values above 98% of TMD are hardly seen in charges. The minimum % TMD requirements in military specification requirements for pressable PBX materials are:

	Milspec requirement	% binder	Typical values achieved (%TMD)
PBXN-3	>98%	14	98,3
PBXN-5	> 96,5%	5	97,7
LX-14	-	4,5	97,2
PBXN-9	Min 1,72 g/cm <sup>3</sup> = 97,2% TMD	8	97,7
PBXW-11	Min 1,77 g/cm <sup>3</sup> = 96,3% TMD	4	96,3

Newman et al are describing a very interesting explosive composition, PBXW-17, in their article. They are stating that %TMD values as high as 98,5% is achievable. As can be seen in the pressing curve in Newman et al it is hard to get above 98,5 % even if higher-pressure force is applied i.e. > 2000 kg/cm<sup>2</sup>. Because of the rubbery consistence of the binder Newman is stating

that to achieve 98,5 - 99% of TMD is extremely difficult which any person skilled in the art would not disagree with.

Based on the above-mentioned explanations the current invention is remarkable. There are examples where % TMD values above 99 are achieved with pressing forces below  $500 \text{ kg/cm}^2$  and with higher but still moderate pressures values at 100 can be achieved! This is indeed nothing one would expect. Increased performance and less sensitive charges are very attractive properties in the ammunition market. In addition the producer of munitions will see benefits relating to safety (lower pressure needed) and improved processability and potentially lower production costs.

The examiner is referring to work related to a different group of PBX materials i.e. Rothstein and his work on cast/cure type of PBX materials. Regarding cast/cure explosive composition as well as melt/cast explosive compositions they are processed in a completely different way than pressable PBX materials. In cast/cure and melt/cast explosive compositions the material is poured or cast not pressed into charges and the parameters controlling the result is obviously different.

Rothstein, teaches the use of multimodal particle size distributions in cast-cured plastic bonded explosives. In this case the explosive crystals (RDX or HMX) are mixed with a cast-curable prepolymer (normally Hydroxy-Terminated PolyButadiene, HTPB) with an isocyanate as curing agent and a cure-catalyst. The production process is to mix the explosive crystals with the HTPB and the other ingredients, pour the explosive mix into the warheads and cure the composition at elevated temperatures for 4-6 days. The main problem with this group of explosive formulations is to be able to mix as much solid material (explosive crystals) as possible with as little prepolymer as possible, and at the same time get a castable, flowable composition that can be poured into the warheads without any entrapped air. Unlike pressable PBX the particles are not forced and crushed into a warhead. In Rothstein the motivation is to achieve a pourable mixture that gives a low viscosity.

The literature describing how to achieve maximum packing density is rich and goes back more than 40 years. The most basic and introductory lesson would be *R.J. Farris: Prediction of the viscosity of multimodal suspensions from unimodal viscosity data, Trans. of the Society of Rheology, 12:2, 1968*). In spite of 40 years of development particle sizes and size distributions are still investigated and discussed, yet without showing the results of the current invention. For

a person skilled in the art it is well known that experience made with one explosive composition cannot be transferred automatically to another explosive composition and especially not between different groups of explosives such as pressable and cast/cure and even not between cast/cure and melt/cast explosive compositions. The teachings of Rothstein et al as well as a number of other similar articles do not represent any obvious motivation for a formulator of pressable explosive compositions.

It is also well known to anyone skilled in the art that particle sizes and surface areas are used to control the burning rate of propellants. Also, modern rocket propellants have strong similarities with cast-cured explosives in that the same type of binder systems is used, together with the same processing and casting technology. However, burning rate is irrelevant for explosives, whether it is cast-cured or pressed. Explosives detonate, and a detonation is completely different from burning both in terms of the physical/chemical process, and the reaction rate. The reaction rate is several orders of magnitude faster for a detonation compared to burning, and the detonation velocity is independent of the explosive particles size.

Based on the above-mentioned explanations the current invention is remarkable. There are examples where % TMD values above 99 are achieved with pressing forces below  $500 \text{ kg/cm}^2$  and with higher but still moderate pressures values at 100 can be achieved! This is indeed nothing one would expect. Increased performance and less sensitive charges are very attractive properties in the ammunition market. In addition the producer of munitions will see benefits relating to safety (lower pressure needed) and improved processability and potentially lower production costs.

The examiners arguments are based on simple assumptions that experience from one area of processing technology can be transferred to another area of processing technology. This is a view which represents an underestimation of the development efforts in explosive community and the current invention.

Gunnar Nevstad  
Gunnar Nevstad

date:

31/10-07